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# **Addendum to Nuclear Materials Events Database (NMED) Quarterly Report**

*Fourth Quarter Fiscal Year 2002*

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## SAFETY HIGHLIGHTS

### Review of Radiography Overexposures (1997 to 2002)

This addendum presents a Safety Highlights report that was not available in time for inclusion in the regular quarterly report. This report represents the results of a review of data, reported to the NRC, involving the reportable overexposures for the period of January 1, 1997, through May 2002.

Total number of individuals who received doses that exceeded regulatory limits (70):

Whole Body dose: 67

Extremity dose: 6

(In three cases, extremity doses were exceeded but whole body doses were not exceeded.)

Approximately 23 percent of reported causes of radiography overexposures were due to failure to survey and follow procedures. Approximately 49 percent of radiography overexposures were administrative overexposures (i.e. overexposures due to poor oversight of workers annual dose). These administrative doses range between 5 rem to 6 rem. Seven of the forty-one overexposures between 5 rem and 6 rem were due to failure to survey and follow procedures.

**Table 1.** Whole Body Doses

Dose range for whole body doses (rem)	Number of individuals exposed
5 - 6	41
6 - 10	14
10 - 25	8
>25	4

**Table 2.** Reported Causes for Whole Body Doses

Whole body dose greater than 25 rem (rem)	Reported cause	Event date
39	Failure to survey and follow procedures	2/16/2001
40	Failure to survey and follow procedures	9/25/2001
70	Failure to survey; could not hear alarming ratemeters due to high noise environment	4/10/2002
77	Possible intentional overexposure to badge	10/1/1999

**Table 3.** Reported Causes for Extremity Exposures

<b>Extremity dose</b>	<b>Reported cause</b>	<b>Event date</b>
730 rem to the hands	Failure to survey and follow procedures	9/25/2001
150 rem to the left hand	Unshielded source during source exchange	11/22/2000
3000 to 5000 rem to index finger	Failure to survey; Inadequate training	12/31/1998
100 to 680 rem to fingers and hands (contract employee)	Inattention of radiographer; radiography was in parking garage	12/16/1998
1500 rem to left calf	Failure to survey and follow procedures	6/1/2000
80 rem to hand	Failure to survey; could not hear alarming ratemeters due to high noise environment	1/13/2001

## Review of Radiopharmacy Extremity Overexposures

This report represents the results of a review of data reported to NRC by radiopharmacies involving hand and finger exposures that exceeded regulatory limits for the period of January 1, 1997, to May 2002. Events reported during this period involved exposures to 126 persons. One event, which occurred over about a five year period, accounted for 116 of the 126 persons. Tables 4 through 6 below summarize the result of the review. Except for the overexposures that occurred from 1995 - 2000 due to a common event, an average of two events were reported annually from 1997 through 2001. While this number may appear low, the overall data suggest that there is a high potential for extremity exposures in excess of regulatory limits. The use of, and frequency of monitoring, dosimetry results, and the use of shielding and remote handling tools (where required) can significantly reduce the potential for extremity exposures.

**Table 4.** Frequency of Reported Occurrences

<b>Year</b>	<b>Number of events</b>	<b>Number of persons</b>
1995 - 2000	Several events reported as one event	116
1998	1	1
1999	2	2
2000	2	2
2001	4	5
<b>Total</b>	<b>9</b>	<b>126</b>

A group of overexposures that occurred over the period 1995 - 2000 due to the same causal factors were reported as one event. The overexposures were discovered during the investigation of an extremity overexposure event that occurred March 31, 2001. The licensee reviewed other production processes at the plant where high hand exposures might have occurred. This investigation resulted in the discovery of a total of 116 extremity overexposures from 1995 through 2000. Sixteen of the exposures were in excess of 250 cSv (rem) SDE, the highest of which was 453 cSv (rem) SDE. The causes of these events were

determined to be insufficient training, a failure to follow procedures, inadequate identification of radiological hazards, and the failure to recognize the radiological implications of some work practices. Over 80 percent (103 of 126) of the extremity exposures were less than 250 rem.

The number of extremity overexposure events reported for 2001 is at least twice the number reported for each of the three preceding years. The reason for this increase was not apparent from a review of the data.

**Table 5.** Task Being Performed by Worker and Associated Cause of Overexposure

<b>Task</b>	<b>Event s</b>	<b>Workers</b>	<b>Reported cause(s)</b>	<b>Does range (rem)</b>
Dispensing routine doses	7	8	Poor handling techniques used during the manual recapping of syringes; Workload too high; Radiopharmacist was new and had slower technique; Worker was in training	51 -151
F-18 dose splitting process	1	1	Instead of using of using the remote handling tool provided, the radiopharmacist handled syringes by hand during preparation of F-18 doses	127
Dispensing bulk doses of Tc-99m	1	1	Radiopharmacist used vial shield without a shielded top and used left index finger to hold vial containing Tc-99m	700
Reworking radiopharmaceutical generators and other production processes	1	117	The individual used his fingers to manipulate needles inside the generator instead of forceps	51 - 1120

One extremity overexposure was calculated to be as high as 1120 rem. This overexposure resulted from an employee working at the rework and packaging stations of a radiopharmaceutical generator manufacturing line. The employee handled a Mo-99/Tc-99m column containing 703 GBq (19 Ci) of Mo-99 and 296 GBq (8 Ci) of Tc-99m with his right hand for 10 to 20 seconds. The individual was supposed to use forceps to manipulate needles inside the generator, but instead used his fingers. Two other events involved specific actions that led to the overexposures. In one event, the worker failed to use a remote handling tool. In the other event, the worker used a vial shield without a shielded top. For 70 percent of the events, workers were involved in routine dispensing of radiopharmaceuticals and received exposures in excess of regulatory limits. These events were due mostly to generally inadequate work procedures.

**Table 6.** Comparison of Dose Dosimetry Reading with Calculated Dose for Events Where the Difference Was Greater than 20 Percent

<b>Exposure</b>	<b>Dose reported by dosimetry (rem)</b>	<b>Dose determined from calculation (rem)</b>
1	34	151
2	5.8	510 - 1120
3	Reported as low (no value)	700

In three of the reported events, the dose calculated for the extremity was substantially higher than the dosimetry reading. In one event, the calculated dose was approximately 200 times higher.

**Table 7.** Common Causal Factors Related to the Occurrence of the Events

<b>Causal factor</b>	<b>Number of events = Yes</b>	<b>Number of events = No</b>
Was extremity dosimetry used?	8	2
Was extremity dosimetry monitored at a sufficient frequency?	2	8
Was overexposure event due to specific incident?	2	8
Was worker receiving exposures experienced?	6	4

Extremity dosimetry was reported to be used in most of the events (8 of 10), but the dosimetry was reported to be adequately monitored in only 20 percent of the events. As a result, most of the overexposure events (8 of 10) resulted from poor oversight of workers quarterly doses (i.e., the overexposure dose accumulated throughout the monitoring period rather than from specific incidents). For 40 percent of the events, the experience of the worker was cited as a contributing factor.